Application of Information Theory, Introduction
Handout Mode

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October 28, 2014

Section 1

Administration

Important Details

1. Iftach Haitner. Schriber 20, email iftachh at gmail.com
   Reception: Sundays 9:00-10:00 (please coordinate via email in advance)

2. Who are you?

3. Mailing list: 0368-4486-01@listserv.tau.ac.il
   - Registered students are automatically on the list (need to activate the account by going to `https://www.tau.ac.il/newuser/`)
   - If you're not registered and want to get on the list (or want to get another address on the list), send e-mail to:
     listserv@listserv.tau.ac.il with the line:
     subscribe 0368-4486-01 <Real Name>

4. Course website:
   `.../~iftachh/Courses/Info/Fall14/index.html`
   (or just Google iftach and follow the link)

Grades

1. Class exam 80
2. Homework 20%: 5-6 exercises.
   - ► Recommended to use use LaTeX (see link in course website)
   - ► Exercises should be sent to nisnis.levi at gmail.com or put in mailbox ?, in time!

and..

1. Slides
2. English

Section 2

Information Theory

Information Theory

- ▶ Started in the paper A Mathematical Theory of Communication by Claude Shannon.
- ▶ A paper in Electrical Engineering (EE).
- ▶ One of the most important scientific papers of the 20'th century. Revolutionized EE, and ideas from this papers are central in almost all area of science: Physics, Mathematics, Computer Science,Chemistry, Biology.
- ▶ An amazing example of an amazing research done by mainly by asking the right questions.

Section 3

The Course

Course Topics

Information Theory is typically taught in EE. In this course we will focus on the point of view of CS and Math, and less on EE applications.

First part of the course will follow Ran Raz course.

- ▶ Axiomatic derivation of Shanon's entropy
- ▶ Conditional entropy and mutual information
- ▶ Relative entropy (Kullback-Leibler information)
- ▶ Entropy of a continuous random variable
- ▶ The maximum entropy principle
- ▶ Huffman coding
- ▶ The asymptotic equipartition theorem
- ▶ Data compression
- ▶ Channel capacity
- ▶ Shearer's inequality
- ▶ Applications to combinatorics
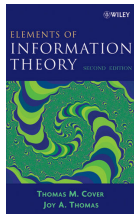- ▶ Kolmogorov complexity

Course Topics cont.

Second part of the course will focus on computational notions of entropy.

- ▶ Parallel repetition of interactive argument
- ▶ Pseudo entropy and pseudorandom generators
- ▶ Accessible entropy and statistically hiding commitments

Material

- Books:
  Thomas Cover & Joy Thomas: Elements of Information Theory.

- Lecture notes:
  Anup Rao: Information Theory in Computer Science.

Prerequisites

Basic probability and calculus.